

SmartConnect Use Case:
C6 - Customer Uses an Energy Management System (EMS)
or In-Home Display (IHD)

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Document History

Revision History

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Approvals

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1. Use Case Description

1.1 Use Case Title

Customer Uses an Energy Management System (EMS) or In-Home Display (IHD)

1.2 Use Case Summary

The SmartConnect advanced metering infrastructure (AMI) is allowing customers to become actively involved in changing their energy consumption habits by connecting their personal control and display devices to the utility grid. This technology also makes it possible for the utility to obtain vital information to maintain power quality and reliability on their systems. There are a variety of SmartConnect programs that the customer can enroll in, that in conjunction with their Smart Appliances and Plug-in Electric Vehicles, enable them to better manage their energy usage and costs. Providing customers with the means to visually monitor information about their energy use from their residence or business helps them to make more educated energy related decisions. Customers with access to Energy Management Systems (EMS) and In-Home Displays (IHD) are more inclined to install energy efficient equipment on their premises and participate in load reduction programs. This use case describes how customers and the utility use these new technologies for improved load management.

The following scenarios will be covered in this use case:

- 1) Customer installs, configures and registers an EMS or IHD for use on their premises.
 - 2) Customer uses the EMS or IHD to manage and adjust energy use.
 - 3) Utility uses the EMS at the customer's premises to control or limit the energy load at that location.
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1.3 Use Case Detailed Narrative

As customers become more interested in control and display devices to increase their knowledge about how much energy they are using and how their energy consumption habits affect their monthly power bills, they tend to become more likely to enroll in cost saving load management programs enabled by Edison SmartConnect. The SmartConnect Home Area Network (HAN) improves communications between the utility and its customers through remote transmission of data and messages regarding energy using SmartConnect meters and control and display devices. Customers equipped with EMS or an IHD are able to receive energy related information on a display device conveniently located at their home or business. The IHD is an information-only device that provides one-way reception of information such as a customer's present energy usage, charges and payments, energy rates, and total energy costs at the premise for a selected period of time or billing interval. A customer Energy Management System (EMS) is a more sophisticated device with the capability of interfacing to the utility using two-way messaging via the

SmartConnect HAN. The EMS provides the customer with a central system to manage their premise energy usage. It can be programmed to take action based on price inputs or event messages from the utility and actual changes to customer's load. It can provide feedback to the utility's SmartConnect system and make setting adjustments in response to changing market and power system conditions. An EMS that controls a multiple residence building is often called the Building Management System (BMS). While the IHD need only register the meter, the EMS must be registered to the particular meter(s) and the individual HAN devices it controls.

Using the system, the utility is able to send messages such as energy conservation alerts or tips, planned outages, energy usage, current tier levels and tariffs, and other energy related information. This information can come from two sources: the central utility customer/device communication system (via SmartConnect NMS) or directly from the meter (via SmartConnect HAN). All IHDs must comply with the Utility AMI HAN System Requirements Specification (Open HAN Specification). This document was developed to be in compliance with these specifications.

In Scenario 1, the customer installs, configures and registers an EMS or IHD that meets the utility's requirements for use at their home or business. The customer registers their IHD or EMS with their local utility. After customer account verification, the utility representative authenticates the premise device and configures and commissions the device on the SmartConnect network. The customer then selects their program preferences for energy information to be delivered to the IHD or EMS.

In Scenario 2, the customer uses their EMS or IHD device to manage and adjust energy use by accessing their most recent usage and pricing data to determine how much energy they are using and the associated costs at their site. The customer can then manually reduce their usage by adjusting the settings on their appliances – for example: seeing that their energy use is excessive, the customer resets their air conditioner's thermostat (turns it up) and views the resulting changes to their energy consumption and cost data on the display device. Customers can receive instantaneous data at their premises and use this data to manage and adjust energy use, operate local distributed energy resources, or install energy efficiency appliances or loads.

In Scenario 3, demand response (DR) event signals are sent from the utility to the customer's EMS to trigger a program that automatically reduces or limits load by interacting with a number of customer HAN devices associated with the EMS. These event signals can be based on differentiated prices, direct load control events, or a percentage of demand reduction.

1.4 Business Rules and Assumptions

- SmartConnect meter is installed at the customer's premises acting as the gateway between the utility and the customer's device.
- SmartConnect connectivity can be established with premise's SmartConnect meter and HAN.
- Registration of EMS or IHD does not require program enrollment (it is possible for the customer to have registered and functioning devices without enrolling in a program).
- Utility can only register pre-approved devices.
- The utility may or may not be the provider of the EMS device. Utility communicates to EMS; EMS is responsible for communicating to HAN devices and registration of HAN devices to the EMS.
- EMS only binds to local devices within range of SmartConnect enabled HAN. The customer/EMS provider is responsible for centralized aggregation of multiple EMS feeds.
- Customer's EMS or IHD equipment is in range of the customer's own SmartConnect Meter(s). Being in range of any other meter e.g. a neighbor's meter is not sufficient.
- Customer gives the utility permission to access/communicate with their premise device.
- The use case focuses on local communications (HAN) at the customer's premises, not on delivery of information to a central/off-site location. A master aggregator of HAN data for multiple meter endpoints, while assumed to be possible is not part of this use case.
- SmartConnect network can be enabled to act as a relay for public broadcast messages.
- The SmartConnect Meter provides the HAN gateway for all IHD and EMS. In the future, it may be possible to provide gateways other than HAN that are not SmartConnect Meter enabled.

2. Actors

Describe the primary and secondary actors involved in the use case. This might include all the people (their job), systems, databases, organizations, and devices involved in or affected by the Function (e.g. operators, system administrators, customers, end users, service personnel, executives, meters, real-time databases, ISO, power systems). Actors listed for this use case should be copied from the global actors list to ensure consistency across all use cases.

Actor Name	Actor Type (person, device, system etc.)	Actor Description
Utility	Organization	A generic term referring to the collection of systems, business functions, and organizations that form an electric utility organization. The term is used whenever the precise actor is unknown or many actors utilize a particular service.
In-Home Display (IHD)	Device	A device installed at the customer's home or business allowing communication with the SmartConnect meter and monitoring of usage and cost data, utility transmitted text messages including reliability or economic events, planned outages, and other useful energy information. Data is passed to this device via the SmartConnect Meter. Utility approved to connect to the SmartConnect network and receive data and communication from the utility.
Customer	Person	Residential or small business energy user that contracts to receive electrical service from a utility and agrees to have a SmartConnect meter installed. May or may not participate in programs provided by the utility such as pricing events, load control or distributed generation.
SmartConnect Network Management System (NMS)	System	The utility's back-office system responsible for two-way communications with SmartConnect Meters to retrieve data and execute commands. Balances load on the communications network resulting from scheduled meter reads. It retries meters during communications failures and monitors the health of the advanced metering infrastructure. Remotely manages and implements firmware updates, configuration changes, provisioning functions, control and diagnostics.
Customer Service System (CSS)	System	Maintains customer contact information, calculates and formats customer bills, receives and applies payments for individual accounts. The system is responsible for storing customer information such as site data, meter number, rates, and program participation.

<i>Actor Name</i>	<i>Actor Type (person, device, system etc.)</i>	<i>Actor Description</i>
SmartConnect Meter	Device	Advanced electric revenue meter capable of two-way communications with the utility. Serves as a gateway between the utility, customer site, and customer's load controllers. Measures, records, displays, and transmits data such as energy usage, generation, text messages, event logs, etc. to authorized systems (i.e., the SmartConnect NMS) and provides other advanced utility functions.
Customer Device Communication System (CDCS)	System	The communications method that notifies customers of demand response events and other related messages. Tracks and uses customer selected preferences for notification (e.g. pager, email, SmartConnect Meter, IHD, EMS, etc.)
Customer Service Representative (CSR)	Person	Utility personnel that respond to customer complaints, outage notifications, and customer requests to activate, modify and/or terminate delivery of service. CSRs also enroll customers in utility sponsored programs and answer questions related to the customer's energy consumption and cost data. Many off-cycle reading, billing, work orders and diagnostics requests are initiated by CSRs in response to customer contact.
Energy Management System (EMS)	System	A customer supplied system for monitoring and managing energy use at their residence or business. It includes human interface displays for interacting with the system and allows the customer to program functions, control loads, and display energy costs, usage, and related information. It can be programmed to take action based upon price inputs or event messages from the utility, or changes to customer's load. Interfaces with HAN devices and the SmartConnect meter.
Third Party Aggregator	Organization	Party external to the utility that provides a service of aggregating demand response capabilities from multiple customers and making this available to the utility and ISO as a resource.

3. Step-by-Step Analysis of Each Scenario

Describe steps that implement the scenario. The first scenario should be classified as either a Primary Scenario or an Alternate Scenario by starting the title of the scenario with either the work “Primary” or “Alternate”. A scenario that successfully completes without exception or relying heavily on steps from another scenario should be classified as Primary; all other scenarios should be classified as Alternate. If there are more than one relevant scenario (set of steps), make a copy of the following section (all of 3.1, including 3.1.1 and tables) and fill out the additional scenarios.

3.1 Primary Scenario: Customer installs, configures, and registers premise EMS or IHD

This scenario describes how the customer registers an EMS or IHD device and if they choose to, enrolls in an EMS or IHD program. The scenario includes customer registration and commissioning of the EMS or IHD device on the SmartConnect network. The customer may include any authorized representative of the customer, including third party aggregators that act on behalf of customer.

Triggering Event	Primary Actor	Pre-Condition	Post-Condition
<i>Identify the name of the event that initiates the scenario</i>	<i>Identify the actor whose point-of-view is primarily used to describe the steps</i>	<i>Identify any pre-conditions or actor states necessary for the scenario to star</i>	<i>Identify the post-conditions or significant results required to complete the scenario</i>
<i>Customer wants to install a display device and view their energy information.</i>	<i>Customer</i>	<i>SmartConnect Meter must be installed and provisioned.</i>	<i>Customer is able to view their energy information on their EMS or IHD device</i>

3.1.1 Steps for this Scenario

	<i>or</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
#	<i>What actor, either primary or secondary is responsible for the activity in this step?</i>	<i>Describe the actions that take place in this step. The step should be described in active, present tense.</i>	<i>Elaborate on any additional description or step value to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.</i>
1	Customer	Customer or third party aggregator initiates request to register EMS or IHD device by contacting utility providing customer information, device type, and device ID. May choose to: contact CSR or account manager, or log on to the utility Web site.	If third party acts on behalf of the customer, the utility must get explicit permission from customer to install devices and access HAN data.
2	CSR/ Utility Web Site	Using the CSS, authenticates identity of customer, customer account, premise location, premise ID. Checks that EMS or IHD device type is available for registration in CSS. Confirms that EMS or IHD device type meets utility requirements.	Customer refers to any authorized representative of the customer or authorized third party.
3	CSR/ Utility Web Site	Presents the customer with EMS or IHD Program information and selections from CSS.	
4	Customer	Selects EMS or IHD program preference and sets program parameters (i.e., current price, current usage and demand, scheduled price, DR events and parameters, current tier, etc.) to be recorded by the CSS.	
5	Customer	Connects IHD or EMS at their premise location.	Note: This can happen before or after the request to register.
6	CSS	Initiates commissioning process request to the SmartConnect NMS to activate customer IHD or EMS onto the SmartConnect system.	

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	<i>or</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
7	NMS	Initiates a communication binding with EMS or IHD via HAN by way of SmartConnect Meter. SmartConnect Meter initiates HAN communications and maintains a secure communications session between the SmartConnect network and Customer EMS or IHD.	
8	EMS or IHD	Transmits the device ID, device type, and SmartConnect Meter ID to the utility over SmartConnect network via SmartConnect Meter.	
9	NMS	Identifies and authenticates SmartConnect Meter ID, and EMS or IHD device ID. Confirms EMS or IHD device meets utility requirements, and is the device ID and type the customer provided earlier.	
10	NMS	Transmits to EMS or IHD device message with authentication parameters via SmartConnect.	
11	EMS or IHD	Receives authentication message and sets authentication parameters.	
12	EMS or IHD	Transmits message to utility via SmartConnect Meter acknowledging receipt of valid authentication messages and parameters.	
13	NMS	Transmits to CCS that the IHD or EMS network connection has been authenticated.	
14	CSS	Transmits to CDCS a request to send IHD or EMS configuration messages.	
15	CDCS	Transmits configuration message to EMS or IHD via HAN by way of SmartConnect Meter.	Configuration message may include utility program group code, pricing configuration messages, etc.
16	IHD or EMS	Updates its configuration according to the message received and sends to CDCS confirmation of receipt of configuration message via HAN by way of SmartConnect Meter.	
17	CDCS	Transmits to CSS a message from IHD or EMS confirming receipt of configuration message	

3.2 Primary Scenario: Customer uses premise EMS or IHD to manage and adjust energy use

This scenario describes how the customer accesses their most recent usage and pricing data with their EMS or IHD display device to determine how much energy they are using and the costs associated with their account. The utility supports the customer by providing energy usage and other related information.

Triggering Event	Primary Actor	Pre-Condition	Post-Condition
<i>Identify the name of the event that initiates the scenario</i>	<i>Identify the actor whose point-of-view is primarily used to describe the steps</i>	<i>Identify any pre-conditions or actor states necessary for the scenario to start</i>	<i>Identify the post-conditions or significant results required to complete the scenario</i>
<i>Customer views their usage and/or generation data on the EMS or IHD display at their premises</i>	<i>Customer</i>	<i>EMS or IHD is installed and commissioned to receive energy information from SmartConnect Meter</i>	<i>Customer will have viewed energy information on their EMS or IHD display and successfully managed and adjusted energy usage at their premises</i>

3.2.1 Steps for this Scenario

Step #	Actor	Description of the Step	Additional Notes
<i>#</i>	<i>What actor, either primary or secondary is responsible for the activity in this step?</i>	<i>Describe the actions that take place in this step. The step should be described in active, present tense.</i>	<i>Elaborate on any additional description or step value to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.</i>
1	Customer	Monitors their energy and cost data on their EMS or IHD at their premises.	

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<i>Step #</i>	<i>Actor</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
2	CDCS	<p>Periodically updates static information regarding customer's enrolled rates, programs, etc. to customer's EMS or IHD, via the SmartConnect Meter.</p> <p>This information includes the following for tiered rate customers:</p> <ul style="list-style-type: none"> a. Utility ID b. Rate label c. Number of price tiers d. Energy allocated to each tier e. Price of each tier f. Billing cycle schedule start and end dates <p>This information included the following for time differentiated rate customers:</p> <ul style="list-style-type: none"> a. Utility ID b. Rate label c. Type of rate <ul style="list-style-type: none"> i. Peak time rate (PTR) ii. Time-of-use (TOU) iii. Critical peak price (CPP) iv. Hourly pricing (e.g. real-time pricing) d. Start and stop time of rate periods, if known e. Price for each rate period, if known f. Billing cycle schedule start and end dates 	<p>Customers can be <u>both</u> tiered rate and time differentiated rate simultaneously. Review Issues 1 & 2.</p>
3	EMS or IHD	<p>Receives updates to static information as provided by CDCS via Premise Gateway associated with SmartConnect Meter over HAN.</p>	

<i>Step #</i>	<i>Actor</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
4	SmartConnect Meter	<p>Transmits to the EMS or IHD via HAN Premise Gateway over HAN energy information as observed by the SmartConnect Meter:</p> <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption demand (kW) and generation demand (kW) (instantaneous watts) 	
5	CDCS	<p>Transmits utility or public notification event messages to the customer's EMS or IHD, via the SmartConnect Meter, as they occur, according to the specific programs and devices the customer's account is enrolled to receive.</p> <p>Messages include the following:</p> <ul style="list-style-type: none"> a. The current date and time (local time) b. Utility messages to customer <ul style="list-style-type: none"> i. Outage in area ii. Energy usage warning (notice of high demand or entering next pricing tier) iii. Rate change coming soon iv. Day ahead price event notification (PTR, CPP) v. New billing period vi. Event in progress vii. End of event viii. Targeted utility messages c. Public energy related messages <ul style="list-style-type: none"> i. Energy shortage alert ii. Grid reliability alert iii. Weather related alert iv. End of alert 	
6	EMS or IHD	Retrieves streaming energy information from SmartConnect Meter via Premise Gateway over HAN and messaging information from CDCS.	

<i>Step #</i>	<i>Actor</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
7	EMS or IHD	<p>Applies static information received periodically in Step 3 with streaming/near real-time information received in Step 6 and calculates information to be made available for customer viewing (IHD case) or to other associated HAN devices (EMS case).</p> <p>Calculated information includes at a minimum:</p> <ul style="list-style-type: none"> a. Energy cost information calculated using “as read” data only b. The energy (kWh) cost in the most recently completed interval c. Total energy (kWh) cost for energy consumed within the current billing cycle d. Total energy (kWh) cost for each tier 	
8	EMS or IHD	Provides information received and/or calculated in prior steps to customer for viewing (IHD Case) or to associated HAN devices (EMS Case).	
9A	Customer	In the IHD Case, views information in IHD and if desired, takes action to modify load.	
9B	HAN Devices	In the EMS Case, those devices associated to the EMS receive information from EMS and take action if necessary according to device settings.	
10	SmartConnect Meter	<p>Transmits to the EMS or IHD updated energy information as observed by the SmartConnect meter:</p> <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption demand (kW) and generation demand (kW) (instantaneous watts) 	
11	EMS or IHD	Retrieves updated streaming energy information from SmartConnect meter and any messaging information from CDCS. Updates cost calculations and provides updated information to the customer for viewing (IHD Case) or to associated HAN devices (EMS Case).	

3.3 Primary Scenario: Utility uses premise EMS for load control or load limiting

This scenario describes how an EMS enabled customer receives a DR event notification. The EMS receives general DR signals from the utility and determines the necessary load reduction to take at the premises. The EMS can then take control of the customer’s HAN devices according to preferences setup by the customer within the EMS. In the future, the utility may prefer to use the EMS as a gateway to receive specific information from HAN devices for monitoring and analysis purposes.

Triggering Event	Primary Actor	Pre-Condition	Post-Condition
<i>Identify the name of the event that initiates the scenario</i>	<i>Identify the actor whose point-of-view is primarily used to describe the steps</i>	<i>Identify any pre-conditions or actor states necessary for the scenario to start</i>	<i>Identify the post-conditions or significant results required to complete the scenario</i>
<p><i>Customer wants to receive DR event notification and other real-time messages on their EMS</i></p> <p><i>A DR event is called</i></p>	<i>Customer</i>	<i>EMS is installed and provisioned to exchange information with SmartConnect Meter and downstream HAN devices associated to the EMS</i>	<i>Customer has received DR event notification or other real-time message to their EMS and EMS successfully executes programmed response to reduce or limit load at their premises</i>

3.3.1 Steps for this Scenario

Step #	Actor	Description of the Step	Additional Notes
<i>#</i>	<i>What actor, either primary or secondary is responsible for the activity in this step?</i>	<i>Describe the actions that take place in this step. The step should be described in active, present tense.</i>	<i>Elaborate on any additional description or step value to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.</i>
1	Customer	Sets EMS preferences on how it should behave upon receipt of different events, depending on factors such as time-of-day, day-of-week, temperature, present load level, etc.	This could involve EMS settings for behavior of multiple individual devices associated to a single EMS.

<i>Step #</i>	<i>Actor</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
2	CDCS	<p>Transmits DR and other energy related information to the EMS:</p> <ul style="list-style-type: none"> a. The current date and time (local time) b. Utility messages to customer <ul style="list-style-type: none"> i. Day ahead event notification (PTR, CPP) ii. DR event start/stop/duration iii. DR event price signals iv. Nominal kW reduction requested v. % of present load reduction requested vi. Event in progress vii. End of event viii. Targeted utility messages c. Public energy related messages <ul style="list-style-type: none"> i. Energy shortage alert ii. Grid reliability alert iii. Weather related alert iv. End of alert 	
3	EMS	Displays for or notifies the customer (or authorized 3 rd Party) regarding DR events and other real-time messages.	EMS setting or utility program preference for paging or other notices asking the customer to provide pending or recently received DR events.
4	Customer	May, at their discretion, override DR event, or adjust EMS settings in response to receipt of DR event message.	Adjustment of EMS settings could have the same or a similar effect as explicit overrides.
5	EMS	Executes programmed response for one or more associated HAN devices to reduce or limit load at customer's premises, based on customer preferences configured into EMS.	Assumes the customer takes responsibility for device registration with EMS and the utility has no visibility to downstream devices.
6	EMS	Measures changes in load at the premises, and presents the information to the customer.	
7	EMS	Receives specific information from HAN devices presenting it to the customer or sending it back to the CDCS for monitoring and analysis purposes (Optional).	(e.g. Battery's state of charge and other observed measurements).

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<i>Step #</i>	<i>Actor</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
8	Customer	Decides whether to take further manual action, adjust EMS settings for additional automated EMS controlled action, or do nothing.	
9	EMS	In the case of override, sends message to CDCS (via SmartConnect Meter/NMS) indicating that the customer has executed an override of a programmed response to an event notification to reduce or limit the customer's load.	Assumes that override notification is required for billing and statistical purposes.
10	CDCS	Sends message to CSS indicating that the customer has executed an override of a programmed response to an event notification to reduce or limit the customer's load.	

4. Requirements

Detail the Functional, Non-Functional and Business Requirements generated from the workshop in the tables below. If applicable, list the associated use case scenario and step.

4.1 Functional Requirements

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
Utility shall use contact methods and processes available and known to the customer. The customer shall have access to a CSR, account manager, or the utility Web site.	3.1	1
Utility shall operate EMS and IHD registration processes and programs for customer enrollment.	3.1	1,2,3,4
The entity referred to as the customer shall include any authorized third party representative of the customer.	3.1	1,2
For commercial accounts, the CSS shall be capable of keeping a list of authorized company representatives and their assigned roles and access levels.	3.1	2
For third parties acting on behalf of customers, the utility shall obtain explicit permission from the customer to install devices and access HAN data.	3.1	1,2
The system shall be capable of supporting requests from commercial accounts to link multiple SmartConnect Meters to an EMS, and to publish energy usage, cost, and other energy related information to the selected EMS.	3.1 3.2	2 6
Utility shall employ a CSS capable of supporting customer requests for participating in EMS and IHD registration processes and programs, and for reviewing customer information and selections. The CSS shall be capable of adding, changing, and deleting customer devices in EMS and IHD programs and changing customer preferences.	3.1	2,3,4
The CSS shall include an operational EMS and IHD program authentication process.	3.1	2
The CSS shall be able to register or enroll only pre-approved devices.	3.1	2
Customer shall be capable of activating an EMS or IHD to communicate with a SmartConnect Meter.	3.1	2,8
CSS shall be able to initiate the commissioning process to activate a customer device onto the system and bind it to the SmartConnect network via a SmartConnect Meter.	3.1	6
The utility shall be required to obtain the customer's permission to communicate with devices on their premises.	3.1	6

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
The NMS shall be capable of initiating communications binding the EMS or IHD via HAN by way of a SmartConnect Meter with the Premise Gateway, for maintaining a secure communications session between the SmartConnect network and a customer's EMS or IHD.	3.1	7
SmartConnect Meter shall be capable of initiating communications binding with the EMS or IHD and maintaining a secure communications session between the SmartConnect network and the customer's EMS or IHD.	3.1	7
All EMS and IHD shall have a unique ID and be capable of transmitting the device ID to the utility via the SmartConnect network and SmartConnect Meter.	3.1	8
NMS shall be capable of identifying and authenticating SmartConnect Meter, EMS and IHD IDs The system shall be capable of confirming whether the EMS or IHD device meets utility requirements and is the device ID and type the customer provided earlier.	3.1	9
NMS shall be capable of transmitting to an EMS or IHD device messages with authentication parameters via SmartConnect.	3.1	10-13
EMS or IHD shall be capable of receiving, executing and confirming authentication parameters from utility.	3.1	11, 12
CSS shall support general/diagnostic configuring of the messaging functions and be capable of transmitting to the CDCS any requests to send IHD or EMS test messages.	3.1	14
CDCS shall be capable of transmitting a configuration message via SmartConnect to an EMS or IHD device.	3.1	15
The customer shall allow the utility to send configuration messages over SmartConnect to the EMS or IHD.	3.1	15
Smart Appliance shall be able to receive and respond to configuration messages initiated by the utility.	3.1	15
Customer/EMS/IHD shall be able to confirm receipt of configuration messages with program information.	3.1	16
CDCS shall be capable of transmitting to CSS messages from IHD or EMS confirming receipt of test messages.	3.1	17
The system shall be capable of supporting multiple language versions of the same message based on customer's selectable preferences.	3.1 3.2 3.3	3,11,12,14 3,5,7,10,11 2,4,6
Customer shall be capable of monitoring their energy and cost data on their EMS or IHD.	3.2	1

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
<p>Periodically, the CDCS shall be capable of updating static information regarding the customer's enrolled rates, programs, etc. to the customer's EMS or IHD via the customer's SmartConnect Meter.</p> <p>This information includes the following for tiered rate customers:</p> <ul style="list-style-type: none"> a. Utility I.D. b. Rate label c. Number of price tiers d. Energy allocated to each tier e. Price of each tier f. Billing cycle schedule start and end dates <p>This information includes the following for time differentiated rate customers:</p> <ul style="list-style-type: none"> a. Utility ID b. Rate label c. Type of rate <ul style="list-style-type: none"> i. Peak time rate (PTR) ii. Time-of-use (TOU) iii. Critical peak price (CPP) iv. Hourly pricing (e.g. real-time pricing) d. Start and stop time of rate periods, if known e. Price for each rate period, if known g. Billing cycle schedule start and end dates 	3.2	2
SmartConnect network shall be able to act as a relay for public broadcast messages.	3.2	2
EMS or IHD shall be capable of receiving updates to static information as provided by the CDCS via a Premise Gateway associated with SmartConnect Meter over HAN.	3.2	3
<p>SmartConnect Meter shall be capable of transmitting to the EMS or IHD via a Premise Gateway over HAN, the following energy information as observed by the SmartConnect Meter:</p> <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption demand (kW) and generation demand (kW) (instantaneous watts) 	3.2	4

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
<p>CDCS shall be capable of transmitting utility or public notification event messages to the customer's EMS or IHD, via the SmartConnect Meter, as they occur, according to the specific programs and devices the customer's account is associated with during enrollment.</p> <p>Messages include the following:</p> <ul style="list-style-type: none"> a. The current date and time (local time) b. Utility messages to customer <ul style="list-style-type: none"> i. Outage in area ii. Energy usage warning (notice of high demand or entering next pricing tier) iii. Rate change coming soon iv. Day ahead price event notification (PTR, CPP) v. New billing period vi. Event in progress vii. End of event viii. Targeted utility messages c. Public energy related messages <ul style="list-style-type: none"> i. Energy shortage alert ii. Grid reliability alert iii. Weather related alert iv. End of alert 	3.2	5
<p>EMS or IHD shall be capable of retrieving streaming energy information from SmartConnect Meter via Premise Gateway over HAN and any messaging information from CDCS.</p>	3.2	6
<p>EMS or IHD shall be capable of applying static information received periodically in Step 3 with streaming/near real-time information received in Step 5 and calculates information to be made available for customer viewing (IHD case) or to other associated HAN devices (EMS case).</p> <p>Calculated information shall include, at a minimum energy cost information for:</p> <ul style="list-style-type: none"> a. Energy cost calculated using "as read" data only b. The energy (kWh) cost in the most recent completed interval c. Total energy (kWh) cost for energy consumed within the current bill cycle d. Total energy (kWh) cost for each tier 	3.2	7
<p>EMS or IHD shall be capable of providing information received and/or calculated in prior steps to the customer for viewing (IHD Case) or to associated HAN devices (EMS Case).</p>	3.2	8
<p>In the IHD Case, customer shall be capable of viewing information in IHD and modifying load if desired.</p>	3.2	9

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
In the EMS Case, HAN devices associated with the EMS shall be capable of receiving information from EMS and taking the necessary action according to the device settings.	3.2	10
SmartConnect Meter shall be capable of transmitting to the EMS or IHD updated energy information as observed by the SmartConnect Meter, such as: <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption and generation demand (kW) (instantaneous watts) 	3.2	11
Customer shall be capable of setting EMS preferences dictating how it will behave upon receipt of different events and dependent on factors such as time of day, day of week, temperature, present load level, etc.	3.3	1
CDCS shall be capable of transmitting to the EMS or IHD the following DR event Information: <ul style="list-style-type: none"> a. The current date and time (in local time) b. Utility messages to Customer <ul style="list-style-type: none"> i. Day ahead event notification (PTR, CPP) ii. DR event start/stop/duration iii. DR event price signals iv. Nominal kW reduction requested v. Percentage of present load reduction requested vi. Event in progress vii. End of event viii. Targeted utility messages c. Public energy related messages <ul style="list-style-type: none"> i. Energy shortage alert ii. Grid reliability alert iii. Weather related alert iv. End of alert 	3.3	2
Customer shall be capable of viewing on an EMS device (or receive notification from EMS) information on DR events and other real-time messages.	3.3	3
Customer shall, at their discretion, be capable of overriding DR events or adjusting EMS settings in response to receipt of DR events.	3.3	4

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
EMS shall be capable of executing programmed responses for one or many associated HAN devices, to reduce or limit load at a customer's premises, based on customer preferences configured into the EMS.	3.3	5
EMS shall be capable of measuring change in load at premises and present the information to the customer.	3.3	6
EMS shall be able to receive specific information from HAN devices and present it to the customer and return it to the CDCS for monitoring and analysis purposes (e.g. battery state of charge and other observed measurements).	3.3	7
Customer shall be capable of deciding whether to take further manual action, adjust EMS settings for additional automated EMS controlled actions, or do nothing.	3.3	8
In the case of override, EMS shall be capable of sending message to CDCS (via SmartConnect Meter/NMS) indicating that the customer executed an override of a programmed response to an event notification to reduce or limit load at customer's premises.	3.3	9
CDCS shall be capable of sending messages to CSS indicating that the customer executed an override of a programmed response to an event notification to reduce or limit load at customer's premises.	3.3	10

4.2 Non-Functional Requirements

<i>Non-Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
All systems shall use open standard message structures for communications between the utility and HAN devices.	3.1 3.2 3.3	7 5 2
EMS and IHD devices shall have the memory capability to store messages for at least 12 hours.	3.2 3.3	3,4,5 1
Messages passed through the network shall be prioritized against other network traffic.	3.2 3.3	3,4,5 1
The SmartConnect meter shall instantaneously update the EMS or IHD with energy usage data.	3.2 3.3	3,4,5 1
Periodic receipt of this type of information shall vary depending on the type of rates/programs the customer is enrolled in.	3.2	2

<i>Non-Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
Delivery time of messages from CDCS, NMS to IHD or EMS (and vice versa) shall take two minutes or less.	3.1 3.2 3.3	7,8,10,12,15,16 2,5 2,8
Delivery time of messages from SmartConnect Meter to IHD or EMS shall be ten seconds or less.	3.2	10

5. Use Case Models (optional)

This section is used by the architecture team to detail information exchanges, actor interactions and sequence diagrams.

5.1 Information Exchange

For each scenario detail the information exchanged in each step.

<i>Scenario #</i>	<i>Step #, Step Name</i>	<i>Information Producer</i>	<i>Information Receiver</i>	<i>Name of information exchanged</i>
<i>#</i>	<i>Name of the step for this scenario.</i>	<i>What actors are primarily responsible for Producing the information?</i>	<i>What actors are primarily responsible for Receiving the information?</i>	<i>Describe the information being exchanged.</i>
3.1	1	Customer	CSR/Utility Web Site	Customer information, financial data, premises address, contact information, customer account number, IHD or EMS type
3.1	3	CSR/Utility Web Site	Customer	IHD or EMS registration and program information
3.1	4	Customer	CSR/Utility Web Site	IHD or EMS registration and program selection and preferences
3.1	6	CSR/Utility Web Site	NMS	Utility requests to the NMS for IHD or EMS commissioning
3.1	7	NMS	IHD or EMS	Binding steps with IHD or EMS performed by the NMS
3.1	8	IHD or EMS	NMS	IHD or EMS identification
3.1	10	NMS	IHD or EMS	Authentication message parameters
3.1	12	IHD or EMS	NMS	Confirmation of authentication messages and parameters
3.1	13	NMS	CSR/Utility Web Site	IHD or EMS network connection authentications
3.1	14	CCS	CDMS	Downloaded test messages
3.1	15	CDMS	IHD or EMS	Downloaded test messages
3.1	16	IHD or EMS	CDMS	Confirmation of receipt of test messages

<i>Scenario #</i>	<i>Step #, Step Name</i>	<i>Information Producer</i>	<i>Information Receiver</i>	<i>Name of information exchanged</i>
3.1	17	CDMS	CCS	Confirmation of receipt of test messages
3.2	2	CDCS	EMS or IHD	<p>Periodical updates of static information regarding customer's enrolled rates, programs, etc.</p> <p>This information includes the following for tier-rated customers:</p> <ul style="list-style-type: none"> a. Utility ID b. Rate label c. Number of price tiers d. Energy allocated to each tier e. Price of each tier f. Billing cycle schedule start and end dates <p>This information includes the following for time-differentiated-rated customers:</p> <ul style="list-style-type: none"> a. Utility ID b. Rate label c. Type of rate <ul style="list-style-type: none"> i. Peak time rate (PTR) ii. Time-of-use (TOU) iii. Critical peak price (CPP) iv. Hourly pricing (e.g. real-time pricing) d. Start and stop time of rate periods, if known e. Price for each rate period, if known f. Billing cycle schedule start and end dates
3.2	4	SmartConnect Meter	EMS or IHD	<p>Energy information as observed by the SmartConnect Meter:</p> <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption demand (kW) and generation demand (kW) (instantaneous watts)

<i>Scenario #</i>	<i>Step #, Step Name</i>	<i>Information Producer</i>	<i>Information Receiver</i>	<i>Name of information exchanged</i>
3.2	5	CDCS	EMS or IHD	<p>Utility or public notification event messages as they occur, according to the specific programs and devices the customer's account is enrolled in.</p> <p>Messages include the following:</p> <ul style="list-style-type: none"> a. The current date and time (local time) b. Utility messages to customer <ul style="list-style-type: none"> i. Outage in area ii. Energy usage warning (notice of high demand or entering next pricing tier) iii. Rate change coming soon iv. Day ahead price event notification (PTR, CPP) v. New billing period vi. Event in progress vii. End of event viii. Targeted utility messages c. Public energy related messages <ul style="list-style-type: none"> i. Energy shortage alert ii. Grid reliability alert iii. Weather related alert iv. End of alert
3.2	7	EMS or IHD	IHD EMS	<p>Static information received periodically in Step 3, streaming/near real-time information received in Step 5, and other calculated information including, at a minimum:</p> <ul style="list-style-type: none"> a. Energy cost information calculated using "as read" data only b. Energy (kWh) cost in the most recently completed interval c. Total energy (kWh) cost for energy consumed within the current billing cycle d. Total energy (kWh) cost for each tier

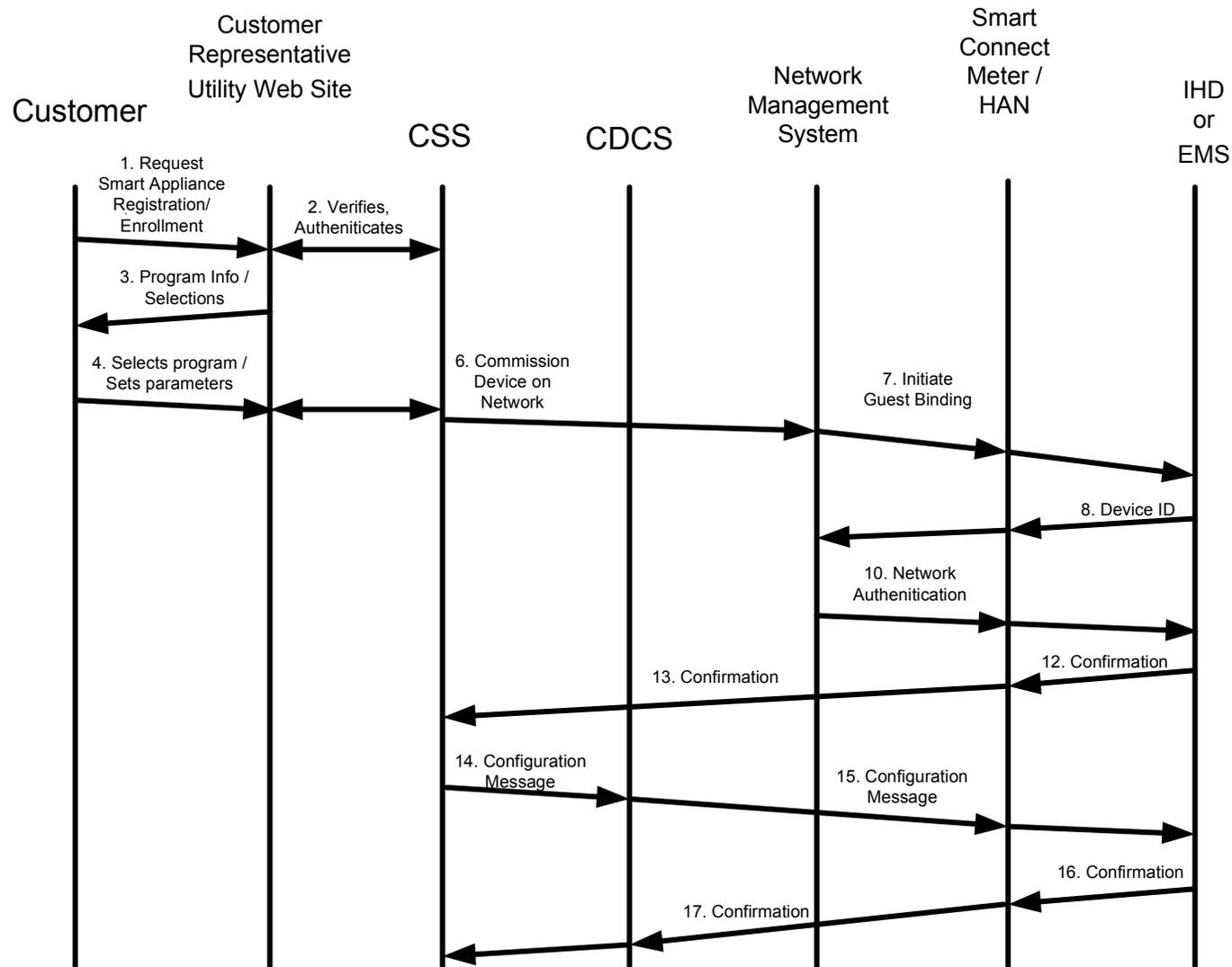
<i>Scenario #</i>	<i>Step #, Step Name</i>	<i>Information Producer</i>	<i>Information Receiver</i>	<i>Name of information exchanged</i>
3.2	10	SmartConnect Meter	EMS or IHD	Updated energy information as observed by the SmartConnect meter: <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption demand (kW) and generation demand (kW) (instantaneous watts)
3.2	11	SmartConnect Meter	EMS or IHD	Updated energy information as observed by the SmartConnect meter: <ul style="list-style-type: none"> a. Amount of energy consumed and generated (kWhrs) in the most recent completed interval b. Total energy consumed and generated (kWhrs) within the current billing cycle c. Current consumption demand (kW) and generation demand (kW) (instantaneous watts)
3.3	2	CDCS	EMS or IHD	DR event and other energy related information <ul style="list-style-type: none"> a. Current date and time (local time) b. Utility messages to customer <ul style="list-style-type: none"> i. Day ahead event notification (PTR, CPP) ii. DR event start/stop/duration iii. DR event price signals iv. Nominal kW reduction requested v. % of present load reduction requested vi. Event in progress vii. End of event viii. Targeted utility messages c. Public energy related messages <ul style="list-style-type: none"> i. Energy shortage alert ii. Grid reliability alert iii. Weather related alert iv. End of alert
3.3	4	Customer	EMS	Override DR event, or adjust EMS settings in response to receipt of DR event.
3.3	6	EMS	Customer	Change in load at premises measured by EMS.

<i>Scenario #</i>	<i>Step #, Step Name</i>	<i>Information Producer</i>	<i>Information Receiver</i>	<i>Name of information exchanged</i>
3.3	8	EMS	CDCS	Message indicating customer executed override of a programmed response to an event notification to reduce or limit load at customer's premises
3.3	9	CDCS	CSS	Message indicating customer executed override of a programmed response to an event notification to reduce or limit load at customer's premises.

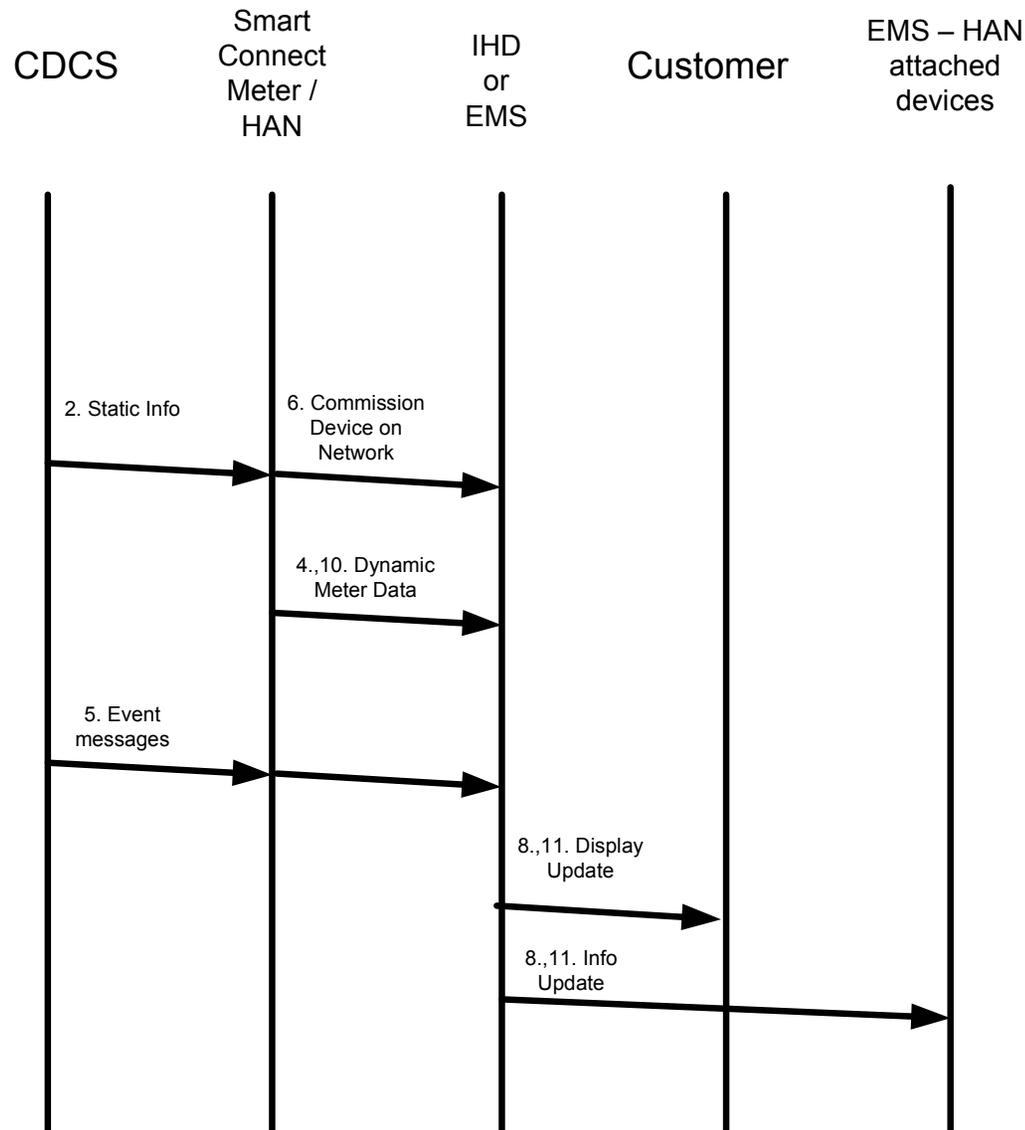
5.2 Diagrams

The architecture team shall use this section to develop an interaction diagram that graphically describes the step-by-step actor-system interactions for all scenarios. The diagrams shall use standard UML notation. Additionally, sequence diagrams may be developed to help describe complex event flows.

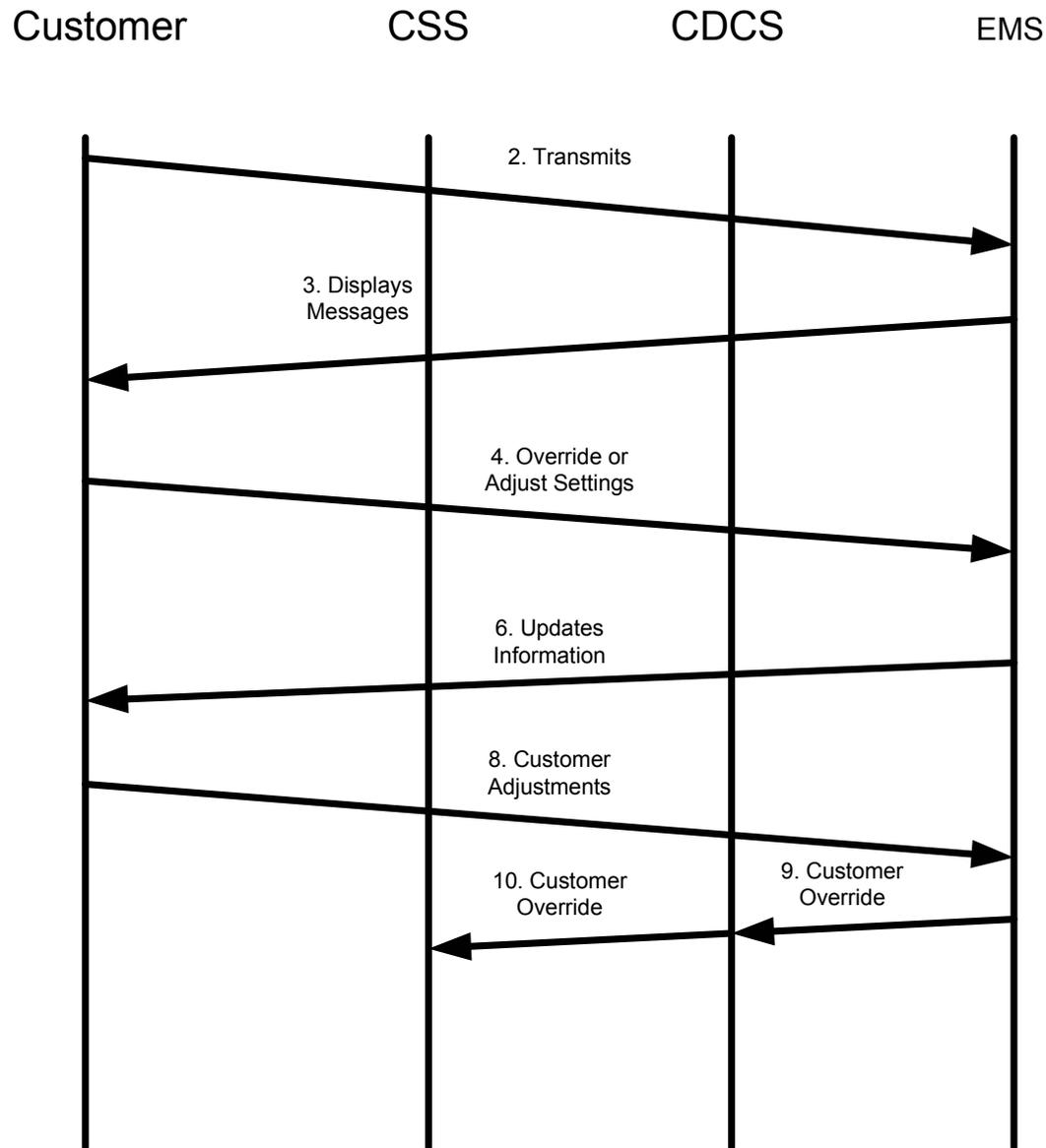
5.2.1 Sequence Diagram: Scenario 3.1



5.2.2 Sequence Diagram: Scenario 3.2



5.2.3 Sequence Diagram: Scenario 3.3



6. Use Case Issues

Capture any issues with the use case. Specifically, those unresolved issues to help the use case reader understand the constraints or unresolved factors that impact of the use case scenarios and their realization.

<i>Issue</i>
<i>Describe the issue as well as any potential impacts to the use case.</i>
Non-functional requirements for periodic receipt of this type of information varies depending on the type of rates/programs the customer is enrolled in.
Need to make sure the information in messages sent to IHD and EMS are consistent with the Open HAN specifications.

7. Glossary

Insert the terms and definitions relevant to this use case. Please ensure that any glossary item added to this list should be included in the global glossary to ensure consistency between use cases.

Glossary	
Term	Definition
SmartConnect	SCE's system name for their Advanced Metering Infrastructure (AMI) implementation. A combination of communications infrastructure and computer applications that provide for remote access to customer meters and advanced applications such as time-of-day metering, remote connect/disconnect, outage information, and demand response.
Home Area Network (HAN)	Local communication network at customer premises that allows devices to communicate with each other.
Time-of Use Rate (TOU)	A rate structure based on a time schedule, daily and throughout the week.
Critical Peak Pricing (CPP)	A rate structure that imposes a very high tariff in times of critical energy supply constraint.
Real Time Peak (RTP)	A rate structure that provides for a peak time rate that varies according to time of day, day of week, and time of year.
Peak Time Rebate (PTR)	A credit provided to the customer who participates in a demand response event and reduces load below a nominal threshold.
Commercial Account	Large customer in both usage and demand. Assigned a customer account manager.
Customer Account Manager	Utility representative assigned to a commercial account.

8. References

Reference any prior work (intellectual property of companies or individuals) used in the preparation of this use case.

Utility AMI 2008 Home Area Network System Requirements Specification

9. Bibliography (optional)

Provide a list of related reading, standards, etc. that the use case reader may find helpful.